Neck on the line-thyroid gland Hormonal and metabolic ataxia

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***Abstract**: Association based Data mining techniques plays an important role in healthcare field for diagnosis the thyroid gland disorder and providing better treatment for the patients in the early stage. Thyroid diseases are, probably, among the commonest endocrine disorders worldwide. India too, is no exception. According to a projection from various studies on thyroid disease, it has been estimated that about 42 million people in India suffer from thyroid diseases.[1] Thyroid diseases are different from other diseases in terms of their ease of diagnosis, accessibility of medical treatment, and the relative visibility that even a small swelling of the thyroid offers to the treating physician. Early diagnosis and treatment remain the cornerstone of management. The thyroid gland is an endocrine gland in your neck. It makes two hormones that are secreted into the blood: thyroxine (T4) and triiodothyronine (T3). These hormones are necessary for all the cells in your body to work normally. Thyroid disorders are very common and tend mainly to occur in women, although anybody - men, teenagers, children and babies, too - can be affected. Thyroid disorders are conditions that affects the thyroid glands. It controls your metabolism, which is how your body turns food into energy. The purpose of this research is predication of thyroid gland disorder in earlier stage and providing medication to the patients at comparably low cost and the number of blood samples will be reduced and also time required to diagnose disease.*

Keyword: *Data Mining, Thyroid disease, Association model, Support vector machine.*

I. INTRODUCTION

The thyroid gland is a butterfly-shaped organ that sits at the front of the neck. It is composed of two lobes, left and right, connected by a narrow isthmus. The thyroid weighs 25 grams in adults,[2] with each lobe being about 5 cm long, 3 cm wide and 2 cm thick, and the isthmus about 1.25 cm in height and width[3].The gland is usually larger in women, and increases in size in pregnancy. The thyroid makes two hormones that it secretes into the blood stream. One is called thyroxine; this hormone contains four atoms of iodine and is often called T4. The other is called triiodothyronine, which contains three atoms of iodine and is often called T3. In the cells and tissues of the body the T4 is converted to T3. It is the T3, derived from T4 or secreted as T3 from the thyroid gland, which is biologically active and influences the activity of all the cells and tissues of your body. The pituitary gland, which is in the brain, helps control the thyroid gland. It releases Thyroid-stimulating hormone (TSH) [4] .The release of TSH into the bloodstream makes the thyroid gland release thyroid hormones. When the pituitary gland detects that thyroid hormone levels are too low, it releases more TSH. If the pituitary gland detects too much thyroid hormone, it releases less TSH. This paper proposes a method for the better guidance about thyroid gland and diagnosis of thyroid gland disorders.

A. LABORATORY STUDIES

Third-generation thyroid-stimulating hormone (TSH) assays are readily available and are generally the most sensitive screening tool for primary hypothyroidism. The generally accepted reference range for normal serum TSH is 0.40-4.2 mIU/L. In the third National Health and Nutrition Examination Survey (NHANES III, 1988-1994), of 17,353 people evaluated, 80.8% had a serum TSH below 2.5 mIU/L; TSH concentrations rose with advancing age. Certain physiologic conditions, such as illness, psychiatric disorders, and significant physical stress (E.g. running a marathon), exposure to extremes in temperature, negative energy balance), can produce marked variations in TSH levels.

B. Thyroid Neck Check

An at-home self-exam known as the "neck check" can help to find thyroidlumps or enlargementson the thyroid gland. These growths may point to any number of thyroid conditions fromnodules and goiterstothyroid cancer. Lumps in the neck can be caused by thyroid disease, and they can also be caused by a variety of other conditions, such aslymph node enlargement, lymphoma, an infectious abscess, or a traumatic injury. In general, a neck check is not considered the most accurate or reliable way to identify thyroid disease. People can have serious thyroid disease they have to take a complete normal neck check. On the other hand, a

major growth can often be a sign of an easily treatable condition, such as aniodine deficiency. In the end, there are limitations as to what a neck check can tell you. A 2017 report from the U.S. Preventive Services Task Force concluded that neck palpation (the manual inspection of the neck) was able to detect thyroid nodules in only 11.6% of cases. Ultrasound, an imaging procedure using sound waves, was five times more accurate in detecting abnormal growths.

C. How to do a Thyroid Neck Check

a. Stand in front of the mirror.
b. Extend the neck back.
c. Take a sip of water.
d. Look for enlargement as they swallow.
e. Feel the bumps and enlargements.
f. Follow up with the endocrinologist.

II. LITERATURE SURVEY

Jameel Ahmed and M. Abdul Rehman Soomrani in have proposed a framework for diagnosing the thyroid disease type. The first phase is data pre-processing in which missing values in the dataset are filled using Medical Data Cleaning (MDC). Second phase is classification. Two SVM classifiers are used here. First one is the multi-SVM used for predicting the thyroid disease type i.e., Thyroid, Hypothyroid, Sub-clinical hypothyroid and Sub-clinical Hyperthyroid.

S.Yasodha et al. have proposed hybridization of Class-Attribute Contingency Coefficient (CACC) - Support Vector Machine techniques. The combination of CACC and SVM classification techniques are applied on thyroid data. When compared to other traditional models, the accuracy of the proposed model is better.

Alfonso Bastia's et al. have aimed at developing a machine learning classifier using AIS for diagnosis of health condition and of the proposed classifier for capability investigation. The proposed classifier successfully improved the thyroid gland disease identification process.

Gurmeet et al. has proposed NN training diagnosis model for the of the thyroid disease. It aims in developing the general model for identifying any kind of disease. The objective of this paper is to thyroid disease diagnose by using three different artificial neural network algorithm having different framework, characteristics and accuracy.

III. HYPOTHYROIDISM

Hypothyroidism, [5] also called underactive thyroid or low thyroid, is a disorder of the endocrine system in which the thyroid gland does not produce enough thyroid hormone. It can cause a number of symptoms, such as poor ability to tolerate cold, a feeling of tiredness, constipation, depression, and weight gain. Occasionally there may be swelling of the front part of the neck due to goiter.
Untreated hypothyroidism during pregnancy can lead to delays in growth and intellectual development in the baby or congenital iodine deficiency syndrome. Salt iodization has prevented hypothyroidism in many populations. Hypothyroidism can be treated with levothyroxine. The dose is adjusted according to symptoms and normalization of the thyroxine and TSH levels. Thyroid medication is safe in pregnancy. While a certain amo1unt of dietary iodine is important, excessive amounts can worsen certain types of hypothyroidism.

IV. HYPERTHYROIDISM

Hyperthyroidism [6] (overactive thyroid) occurs when the thyroid gland produces too much of the hormone thyroxine. Hyperthyroidism can accelerate the body's metabolism, causing unintentional weight loss and a rapid or irregular heartbeat.

Several treatments are available for hyperthyroidism. Doctors use anti-thyroid medications and radioactive iodine [7] to slow the production of thyroid hormones. Sometimes, hyperthyroidism treatment involves surgery to remove all or part of the thyroid gland.

Although hyperthyroidism can be serious if ignore it, most people respond well once hyperthyroidism is diagnosed and treated. Hyperthyroidism can mimic other health problems, which can make it difficult for the doctor to diagnose.

It can also cause a wide variety of signs and symptoms, including:

- Unintentional weight loss, even when your appetite and food intake stay the same or increase
- Rapid heartbeat (tachycardia) — commonly more than 100 beats a minute
- Irregular heartbeat (arrhythmia)
- Increased appetite
- Tremor — usually a fine trembling in your hands and fingers
- Sweating
- Changes in menstrual patterns
- Changes in bowel patterns, especially more frequent bowel movements
- An enlarged thyroid gland (goiter), which may appear as a swelling at the base of your neck
- Fatigue, muscle weakness
- Difficulty sleeping
- Skin thinning
- Fine, brittle hair

V. COMMON SYMPTOMS AND GUIDANCE

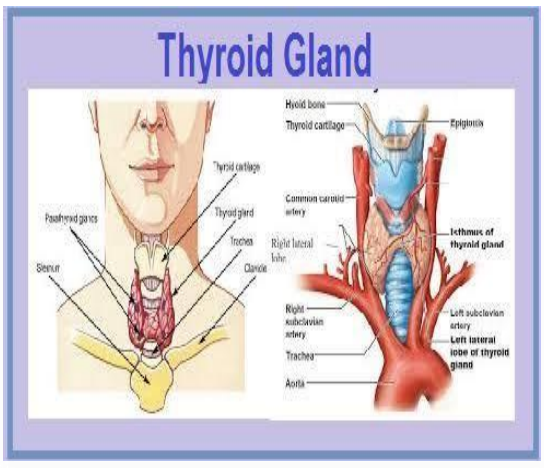
Hypothyroidism side-effects are tiredness, feeling cold, weight gain, poor concentration, depression. For hyperthyroidism weight loss, heat intolerance, anxiety, and, sometimes, sore and gritty eyes. Sometimes there are very few symptoms.

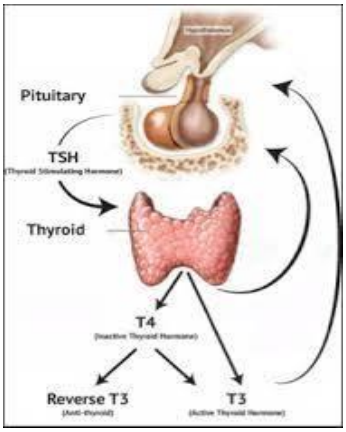
A blood test from your doctor will confirm whether or not you have a thyroid disorder. There has to be some sort of mechanism that regulates very carefully the amount of T4 and T3 secreted by your thyroid gland so that the right - the normal - amounts are manufactured and delivered into the blood stream.

The mechanism is very similar to that which regulates the central heating in a house where there is a thermostat in, say, the living room, which is set to a particular temperature and which activates the gas- or oil-fired furnace, or boiler that heats the hot water. In the case of the thyroid the 'thermostat' consists of a little gland, called the pituitary gland that lies underneath your brain in your skull.

The pituitary [8] senses the level of thyroid hormones in your blood stream, just as the thermostat in your living room senses the temperature. Under normal circumstances, if the level drops just a little below normal, the pituitary reacts by secreting a hormone called the thyroid stimulating hormone, also known as TSH, and this hormone activates the thyroid gland to put out more T4 and
T3.Conversely, when the thyroid hormone levels rise above normal the 'thermostat' senses this and the pituitary stops secreting TSH so that the thyroid gland stops working so hard and the secretion of T4 and T3 is reduced.

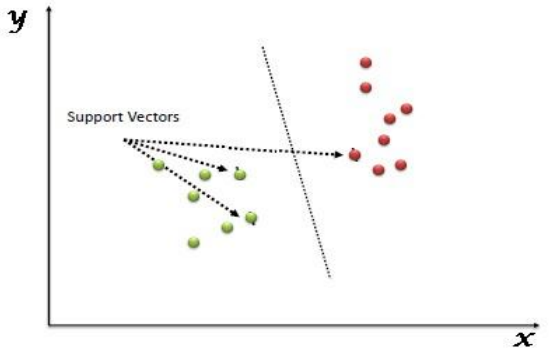
VI. THE THYROID GLAND





VII. SUPPORT VECTOR MACHINE

"Support Vector Machine" (SVM)[9] is a supervised machine learning algorithm which can be used for both classification and regression challenges. However, it is mostly used in classification problems. In this algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane [10] that differentiate the two classes very well (look at the below snapshot).



Support Vectors are simply the co-ordinates of individual observation. Support Vector Machine is a frontier which best segregates the two classes (hyper-plane/ line).

There are different approaches for multiclass SVM classification. Two main approaches are one-versus-one and 1one-versus-rest approach. One-versus-all approach is used here. Four binary SVM classifiers are used here for classification. Hyperplane is determined by the kernel function. For non-linear classification, usually used kernel functions are polynomial, radial basis function (RBF), and sigmoid function. RBF is used here as the kernel function. The value of RBF depends only on the distance from the origin, i.e.

$$\Phi(X) = \| \Phi(X) \| \qquad (1)$$

Parameter selection is very important in SVM classification Main parameters are Error penalty parameter (C) and Gamma. If C is small then the decision surface will be smooth. When it is high training samples can be classified correctly. The model behaviour is sensitive to gamma. Equation for velocity update is given below:

$$Yi\ (k+1) = \omega\ Yi\ (k) + C1\ R1\ (P\ Best - Xi\ (k)) + C2\ R2\ (G\ Best - Xi\ (k)) \quad (2)$$

Where, ω, C1, C2 are constants. R1, R2 are random variables.

Equation for position update is as follows:

$$Xi\ (k+1) = Xi\ (k) + Yi\ (k+1) \quad (3)$$

Training set forms the swarm here. Swarm size is equal to the size of the dataset. C1, C2 are taken as 2. Here, PSO is used for the optimization of two parameters, so that problem dimension will be 2. Maximum number of iteration is set to 100. After completing the specified number of iterations, parameters are selected from the best position of the particle in the swarm.

VIII. NORMAL THYROID LEVEL

TEST	ABBREVIATION	TYPICAL RANGES
Thyroxine Serum	T4	4.6-12 ug/dl
Triiodothyronine Serum	T3	80-180 ng/dl
Thyrotropin Serum	TSH	0.5-6 uU/ml

CONCLUSION

Thyroid gland dysfunction is a common cause which can be easily managed by correcting the appropriate level of thyroid hormones. However, by taking a small sample of your blood he or she can assess exactly your thyroid secretory state for diagnosing the disease. Most thyroid disorders are treated with daily medication. There are other treatments for those thyroid disorders that cannot be controlled with medication. People with thyroid disorder have plenty of options for a healthy living. This research can also give disease description and providing medication to the patients at comparably low cost and the number of blood samples will be reduced and also time required to diagnose disease that may helpful to the users and healthcare industry.

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